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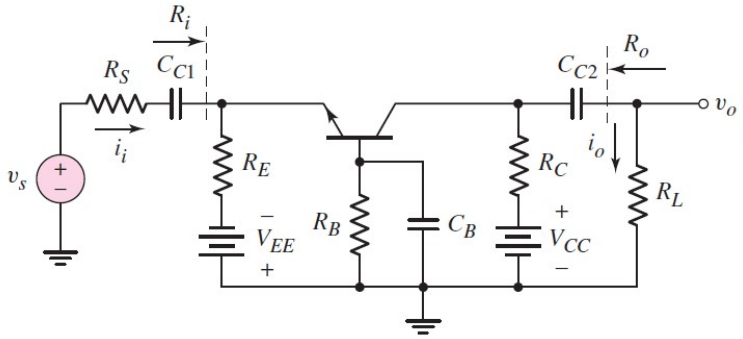
ECE322L -Homework 9 (100 points)
Assigned on Thursday, 04/09/2020-11 am
Due on Thursday, 04/23/2020-11 am

Consider the circuit below. The transistor parameters are: β=120, $V_{BE(on)}$=0.7 V, V_A=∞. The circuit parameters are V_{CC}=V_{EE}=3.3 V, R_S=500 Ω, R_L= 6 kΩ, R_B=100 kΩ, R_E=12 kΩ, R_C=12 kΩ.
(a) Calculate the average power dissipated in the transistor and R_C, for v_s=0.
(b) Determine the maximum undistorted signal power that can be delivered to R_L, and the resulting average power dissipated in the transistor and R_C.



(a) $$I_{BQ} = \frac{V_{EE} - V_{BE(on)}}{R_B - (1+\beta)R_E} = \frac{3.3V - 0.7V}{100k\Omega + (121)12k\Omega} = 1.6753\mu A$$

$$I_{CQ} = \beta I_{BQ} = 120 \times 1.6753\mu A = 201.03\mu A$$

$$V_{CC} - I_{CQ}R_C + I_{BQ}R_B - V_{BCQ} = 0 \rightarrow$$

$$V_{BCQ} = 3.3V - (201.03\mu A)(12k\Omega) + (1.6753\mu A)(100k\Omega) = 1.0552V$$

Average Power dissipated in the transistor

$$\overline{P_Q} = I_{CQ}V_{BCQ} = (201.03\mu A)(1.0552V) = \boxed{212.12\mu W}$$

Average Power dissipated in R_C

$$\overline{P_{R_c}} = I_{CQ}^2 R_C = (201.03\mu A)^2 (12k\Omega) = \boxed{484.96\mu W}$$

(b) $$\overline{P_{R_L}} = \frac{V_{out}^2}{R_L} = \frac{\left(I_C (R_C \parallel R_L)\right)^2}{R_L} = \boxed{53.885\mu W}$$

$$\overline{P_Q} = I_{CQ}V_{BCQ} - \frac{1}{2}I_C^2 (R_C \parallel R_L) = \boxed{131.29\mu W}$$

$$\overline{P_{R_c}} = I_{CQ}^2 R_C + \frac{1}{2}I_C^2 R_C = \boxed{606.2\mu W}$$